ON THE STRUCTURE OF THE ORANG OUTANG.

BY HENRY C. CHAPMAN, M. D.

Various parts of the Orang, *Simia satyrus*, L., have been dissected, described, and figured by Tiedemann,[1] Owen,[2] Sandifort,[3] Cuvier,[4] Schroeder van der Kolk and Vrolik,[5] Rolleston,[6] Selby,[7] Huxley,[8] Bischoff,[9] Barnard,[10] Langer,[11] Gratiolet,[12] Spitzka,[13] and others. It was hardly to be expected, the subject having been investigated by such eminent observers, that I could hope to find anything particularly new to science. It occurred to me, however, that it might not be altogether useless to bring to the notice of the Academy a general resumé of the results of my dissection of the Orang that died at the Philadelphia Zoological Garden in February last, more especially as the memoirs referred to below are scattered through the journals, and are often limited to descriptions of certain parts of the animal only, such as the brain, muscular system, etc.

My Orang was a young male, supposed to be about three years old. The following measurements were taken: From vertex to rump, 16 inches; upper extremity, 20½ inches; arm, 7 inches; forearm, 8 inches; hand, 5½ inches; lower extremity, 17½ inches; thigh, 5 inches; leg, 6 inches; foot, 6½ inches. What struck me at once was the length of the upper extremity, it being 3 inches longer

[1] Tiedemann, Zeit. Phys. Darmstadt, 1827.
[2] Owen, Proc. Zool. Soc., i, 1830, 1831.
[3] Sandifort, Ontleerhundige Beschryving, Leiden, 1840.
[4] Cuvier and Laurillard, Planches, 1849.
[5] Schroeder van der Kolk and Vrolik, Verhandelingen Kon. Nied. Inst., 1849; Verslagen Kon. Acad., 1862.
[6] Rolleston, Nat. Hist. Rev., 1861.
[7] Selby, Nat. Hist. Rev., 1861.
[8] Huxley, Med. Times, 1864.
[9] Bischoff, Munich Abhand. 1870.
[10] Barnard, Proc. American Assoc., 1876.
[11] Langer, Sitzungsberichte, Wien, 1879.
[12] Gratiolet, Plis Cerebraux des Primates, no date.
[13] Spitzka, Journal of Mental and Nervous Diseases, 1879.

NOTE.—I regret that when dissecting the Gorilla I was unacquainted with Mr. Macalister's valuable paper in the Proceedings of Royal Irish Academy for 1873.

than the lower one, the Orang agreeing nearly in this respect with the Gorilla[1] which I dissected, the difference in the extremities in that animal being $3\frac{1}{2}$ inches, whereas in the Chimpanzee[2] I found only a difference of $1\frac{3}{4}$ inches. The foot in the Orang, however, was $\frac{1}{2}$ inch larger than the hand, whereas in the Gorilla the hand was $\frac{1}{2}$ inch larger than the foot; in the Chimpanzee the difference in this respect was $\frac{3}{8}$ inch in favor of the foot. The foot in the Orang, however, resembled superficially a hand much more than it does in the Gorilla. Indeed the distinctness of hand and foot superficially is more marked in the Gorilla than in the other anthropoids. I found the thoracic, abdominal and pelvic visceræ perfectly healthy. The animal seemed to have died from congestion of the brain; there was also some cerebritis. As the osteology of the Orang has been thoroughly described by Prof. Owen[3] and others it will not be worth while for me to dwell on that part of its organization. I will pass therefore to the muscular system, and more particularly to that of the extremities, as being the most interesting as compared with man.

Muscular Systems.—In Prof. Bischoff's[4] paper on the Gorilla an excellent figure is given of the muscles of the face of the Orang, from a preparation by Rudinger. These muscles were described by Prof. Owen,[5] but not figured. The same facial muscles are found in man and the Orang with the exception that there is but one zygomaticus possibly corresponding to the zygomaticus minor of man, though on account of its size it may represent both the zygomaticus major and minor. The facial muscles in the Orang are not as well differentiated as in man, rather hanging together. I noticed that the digastricus had only the posterior head. There was nothing peculiar, however, about the sterno cleido mastoid, omohyoid, or the scaleni. The omocervicalis or elevator claviculæ passed from the transverse process of the atlas to the acromial end of the clavicle, as I found it in the Chimpanzee and in the Gorilla. The pectoralis major arose in three portions: the first, from sternum and first intercostal space; the second, from sternal part of third, fourth, fifth, and sixth ribs, and the third from costal

[1] Proc. of Acad. of Nat. Sciences, Philadelphia, 1878.
[2] Proc. of Acad. of Nat. Sciences, Philadelphia, 1879.
[3] Trans. of Zool. Society, 1835.
[4] Beitrage, Munich Abhand., 1879.
[5] Proc. of Zool. Society, i, 1830, p. 28.

portion of fourth, fifth, sixth and seventh ribs. This distinction in origin is partly visible even in man. There was nothing noticeable about the pectoralis minor or subclavius, supraspinati or teres. The latissimus dorsi, as in all monkeys, gave off the slip the latissimo condyloides, which, however, in the Orang scarcely reached the condyle, and was pierced by the ulnar nerve. The biceps, triceps, and brachialis anticus were well developed, and the external cutaneous nerve passed through the coraco-brachialis as in man. The anterior aspect of the forearm was quite human. The pronator radii teres arose by two heads, between which passed the median nerve. The flexor carpi radialis and ulnaris and the palmaris longus were well developed. The flexor sublimis did not differ from that of man. The flexor profundus was rather separated into two portions, one for the under and the other for the remaining fingers. There was no trace of a flexor longus pollicis either as a distinct muscle or as a slip from the flexor profundus. The abductor, flexor brevis, adductor and opponens pollicis, abductor flexor brevis, and opponens minimi digiti, and the lumbricales were all present. As regards the back of the forearm, the supinator longus arose higher than in man. The supinator brevis, and extensor radialis longior and brevior, extensor ossi metacarpi pollicis and exterior secundi internodii pollicis did not differ from those in man. The absence of an extensor primi internodii pollicis was noticeable, as was also the fact of the extensor indicis giving a slip to the middle finger and the extensor minimi digiti one to the ring finger, making eight tendons supplying the back of the fingers with the four from the extensor communis digitorum. The interossei were the same as in man. Briefly, the upper extremity of the Orang in its muscles differed essentially from that of man in the absence of the flexus longus, and primi internodii pollicis and in the presence of the additional tendons to the ring and middle fingers. The Orang agreed with the Gorilla in not having a flexor longus pollicis, but disagreed with it in having the pronator radii teres arising by two heads, in the presence of a palmaris longus, in the additional tendons for ring and middle fingers, and in not having the extensor primi internodii pollicis. As compared with the Chimpanzee, the Orang agreed in reference to the pronator radii teres and palmaris longus, but in the extensor ossi metacarpi pollicis being single, and in the absence of the flexor longus pollicis as a slip from the pro-

fundus, and in the presence of the additional extensor tendons it differed.

As might be expected from the elongated form of the pelvis and the absence of the round ligament of the hip-joint in the Orang, the glutei muscles differ somewhat from those of man. The glutæus magnus (Pl. 12, *e*) in the Orang—not as large or as fleshy as its glutæus medius—is inserted together with the tensor vaginæ femoris, which is scantily developed, if at all, into the fascia lata of the thigh, the glutæus medius being inserted into the great trochanter. Parallel with the lower edge of the glutæus medius (Pl. 12, *c*), is seen a small muscle rising from the edge of the great sciatic notch, and inserted into the great trochanter (Pl. 12, *b*). This muscle seems to correspond to part of the pyriformis in man, the sacral portion of the muscle not being developed in the Orang. The glutæus minimus is represented by a muscle arising from the external edge of the ileum, and passing almost vertically downwards until inserted into the great trochanter, close to the pyriformis (Pl. 12, *a*). At first sight this muscle seems much displaced if it is the glutæus minimus, but if one can imagine the ileum (Pl. 12, *d*) in the Orang to be widened outwardly to the same extent as seen in man, there would be little or nothing anomalous about the muscle. From the position of the glutæus minimus in the Orang, it would seem that this muscle would supplement, to a certain extent, the want of the ligamentum teres, which, it will be remembered, is absent in this ape.

In the Chimpanzee there is so little that is peculiar about the glutæus minimus that I had no difficulty in identifying it, and the same can be said of the Gorilla. In the account of the Chimpanzee by Traill[1] however, the glutæus minimus is described as a distinct new muscle, the scansorius; the muscle I have described as pyriformis, Traill regarded as the glutæus minimus, the pyriformis, according to Traill, being absent. Since then, this so-called scansorius muscle has been referred to by Bischoff, Owen, Huxley and others, as a distinct muscle. With all deference to such eminent anatomists, I cannot see any essential difference between the scansorius of Traill, and the glutæus minimus in man.[2]

[1] Wernerian Transactions, p. 18, 1821.

[2] On looking up the literature upon the anatomy of the Orang, I find that in 1876 Prof. Barnard, *op. cit.*, considered the scansorius as being homologous with the glutæus minimus, and mentioned in his paper that

The obturators, gemelli and quadratus femoris, were well developed. There was nothing peculiar about the muscles of the thigh either on the anterior or posterior surface; the rectus arose, however, only from the inferior spine of the ileum. In the leg anteriorly, I noticed the tibialis anticus divided into two tendons; otherwise, the muscles were as in man. The peroneus longus and brevis were well developed, but there was no peroneus tertius. The soleus, as usual in monkeys, had only the plantar head, and there was no trace of a plantaris, although, according to Sandifort, it is present. The flexor longus digitorum supplied the perforating tendons for the second and fifth, the flexor longus hallucis those for the third and fourth digits. There was no slip from the longus hallucis for the big toe, that muscle, therefore, except from its origin, scarcely deserves that name. The flexor brevis digitorum supplied the perforated tendons for the second and third toes. Those for the fourth and fifth came off from the flexor longus digitorum. The tendon for the fifth toe was not perforated. There was a connecting slip between the third and fourth tendons. The external head only of the flexor accessorius was present. In addition to the abductor, flexor brevis and adductor of the hallux, there was a well-marked opponens hallucis. The lumbricales for the second and fifth digits came from the flexor longus digitorum, those for the third and fourth digits from the flexor longus hallucis. The abductor and flexor brevis minimi digiti were well developed, but there was no transversus pedis. The interossei were like those of the hand. Briefly, as compared with man, the leg and foot of the Orang differ in the absence of the peroneus tertius, plantaris, flexor longus hallucis and transversus pedis, in the fibular origin of the soleus, and external origin of accessorius only, in the distribution of the perforating and perforated tendons for the toes, in the interossei, and in the presence of an opponens for the big toe. In this latter respect the Orang differs not only from man, but from all the other monkeys and anthropoids, the foot having a very hand-like appearance, as compared with that of the Gorilla and Chimpanzee. The foot of the Orang differs further in the absence of a special

Prof. Humphrey held essentially the same opinion. I was not aware, until I had finished my dissection, of the views previously published by these anatomists, and am glad to have been able, independently, to come to the same conclusion.

flexor for the big toe. This is supplemented to a certain extent by the opponens, and in a partly developed accessorius. The perforated tendon for the fifth toe in the Gorilla came from the flexor longus hallucis, whereas in the Chimpanzee and Orang it is supplied by the tendon of the longus digitorum. If Prof. Huxley's canon be accepted that the distinction between a hand and a foot consists in the latter possessing tarsal bones, the peroneus longus and brevis, the short extensor and short flexor muscles, then the posterior extremity of the Orang terminates in a foot. It appears to me, however, that the difference between the hand and foot in man, the Gorilla, Chimpanzee, and the lower monkeys, is greater than that observed between the corresponding members of the Orang.

Alimentary Canal, etc.—It is usually stated that the uvula is absent in the Orang, and, on looking into the mouth, at first sight this appears to be the case, as it does not hang down as in man between the pillars of the fauces—nevertheless it exists. I found it pointing directly backwards in a straight line from the posterior palatine spine. It contained the azygos uvulæ muscle. Prof. Bischoff[1] mentions also finding the uvula in the Orang. The circumvallate papillæ of the tongue are disposed in the form of a Λ, as in man; I found this to be the case in the female Chimpanzee,[2] of which I gave an account, and also in a male which I had the opportunity recently of dissecting. The salivary glands with their ducts were well developed, the submaxillary being very large both relatively and absolutely, as compared with man. The stomach in the Orang (Pl. 13, fig. 1) is not so human in its form as that of either the Gorilla or the Chimpanzee, the cardiac portion, two-thirds of the stomach, being more elongated and constricted from the pyloric part, which was tubular. The greater curvature measured 6 inches, the less 4. The small intestine was 8 feet 4 inches in length, the large 4 feet. The constant presence of valvulæ conniventes in the small intestine of the Orang appears even at the present day questionable by some anatomists. In speaking of these folds occurring in the Gorilla, Bischoff[3] refers to Owen not finding them in the Orang, while they are said to exist by Sandifort, Mayer and Barkow. As to his own opinion on the subject, he expresses himself as follows: "Die beiden jetzt auf's Neue

[1] Beitrage sur Gorilla, p. 37. [2] Op. cit., p. 57. [3] Op. cit., pp. 40, 41.

von mir untersuchten Dünndärme des Orangs aus Dresden und aus der hiesigen Zoolog. Sammlung, sowie der eines Zweiten Chimpanzee aus Dresden, zeigen keine Spur der genannten Falten. Ich halte nach alle diesem ihre Gegenwart beim Orang und Chimpanzee für zweifelhaft; beim Gorilla, wenn gleich in schwacher Entwicklung, für gewiss; individuelle Verscheidenheiten sind doch in einem solchen Punckte nicht wahrscheinlich." I found indications of valvulæ conniventes in the Orang, but of the most rudimentary character as compared with man. In places they run parallel with the long axis of the intestine (Pl. 14, fig. 2), then transversely as in man (Pl. 14, fig. 3), then again as at first, and afterwards again transversely. They are found in parts of the jejunum and ileum. The valvulæ conniventes I found very well developed in the male Chimpanzee (Pl. 14, fig. 4), but not at all in the female. I noticed in the Orang the villi and solitary glands; the Peyer's glands were very well developed. I counted fifteen, some of which measured 4 inches in length. The cæcum and ileocolic valve did not differ from the same parts in man. The vermiform appendix attained a length of $6\frac{1}{2}$ inches absolutely, and was relatively much larger than that of man, reminding one of the condition of this structure in the human embryo. As regards the large intestine, the only noticeable peculiarities were the large size of the solitary glands, and the fact that the mucous membrane of the ascending colon was thrown into well-marked longitudinal folds, with transverse connecting ones, exhibiting quite a reticulated appearance (Pl. 14, fig. 1). This is not the case in the Chimpanzee. The peritoneum was disposed as in man. The transverse colon was connected with the stomach, as was also the case in the Chimpanzee, and Prof. Bischoff[1] noticed that this obtains also in the Gorilla. As is well known, the transverse colon in the monkeys can be raised entirely without drawing up with it the stomach, with the exception sometimes of the Macacques, in which I have noticed a slight peritoneal connection between pyloric part of stomach and colon, indicating a beginning of a gastrocolic omentum? I did not notice anything peculiar about the spleen or pancreas. The quadrate lobe of liver was absent; the spigelian lobe, however, was very well developed; the hepatic duct opened at a little distance from the pancreatic. I found in the small intestine, five fine specimens of

[1] Op. cit., p. 39.

the *Ascaris lumbricoides*, and one in the large, and in the cæcum a *Trichocephalus dispar*. I believe this is the first time these entozoa have been found in the same anthropoid. According to Diesing[1] the *Trichocephalus* is found in the Orang, and Cobbold[2] states that Murie sent him an *Ascaris* from the Chimpanzee.

Respiratory System.—In the Orang, as in the Gorilla and Chimpanzee, particularly in the males, the ventricles of the larynx are prolonged into the so-called laryngeal pouches. In young specimens of the anthropoids, these pouches, though not so well developed as in the adults, can usually, however, be perfectly identified. In dissecting my Orang, after removing the skin in the cervical region, I noticed what appeared to me to be the laryngeal pouches, and by passing a tube into one of the ventricles of the larynx, the pouch of that side could be readily inflated. On tracing, however, the anterior wall of the pouch downward, I noticed that it was attached to the front of the sternum and clavicle, and on opening the pouch and following its posterior wall, I found it attached to the back of the sternum and first rib. Thus the interior of the pouch corresponded with the space between the two layers of the cervical fascia in man, usually filled with fat and absorbent glands, but in the Orang it is empty and communicating with the interior of the larynx. The pouch was not lined with mucous membrane, resembling the remaining fascia, which was indeed continuous with it. Supposing that my dissection really represented the true relation of these parts, then, morphologically speaking, the laryngeal pouch in the anthropoids would be homologous with and replace the two layers of the cervical fascia in man, so familiar to the surgeon. There was nothing especially noticeable about the vocal cords, epiglottis or trachea. The lungs (Pl. 13, fig. 2), however, were not divided into lobes as in the Gorilla and Chimpanzee.

Vascular System.—I did not notice about the heart anything especially different from the human. In reference to the origin of the vessels, however, the innominate gave off the left carotid and continuing an eighth of an inch then divided into the right carotid and right subclavian, the left subclavian coming off separately from the aorta (Pl. 13, fig. 2). In the Gorilla and male Chimpanzee I found the disposition of these vessels the same as in man, which is the case in the Orang, according to Sandifort. In the female Chimpanzee there were two innominates, a long and a

[1] Helm., vol. ii, p. 534. [2] Entozoa, p. 291.

short one, the latter dividing into left carotid and subclavian. The arteries and veins of the extremities did not differ from those of the Gorilla and Chimpanzee. I found in the Orang, as in them, the "long saphenous artery" accompanying the nerve and vein of same name. The mesenteric vessels exhibited loops along the borders of intestine.

Genito-urinary Apparatus.—The general appearance of these structures resembled strikingly those of man (Pl. 15). The kidney measured $1\frac{1}{4}$ inches in length, and exhibits only one papilla. The ureters were 5 inches long. The bladder was 2 inches in length and 1 in diameter. The testicles measured $\frac{6}{8}$ of an inch in length, and were situated near the inguinal canal. The cavity of the tunica vaginalis testes was shut off from the general peritoneal cavity. The vas deferens was 4 inches in length, the seminal vesicle 1 inch; the seminal duct was very short. The caput gallinaginis was well developed, as was also the prostate. The penis measured 2 inches in length, the glans was of cylindrical shape. There was no bone in the penis. The Cowper's glands were relatively large.

Nervous System.—The brain of the Orang has been figured by Tiedemann, Sandifort, Schroeder van der Kolk and Vrolik, Gratiolet, Rolleston, etc. On account, however, of the few illustrations extant, and of the importance of the subject, I avail myself of the opportunity of presenting several views of my Orang's brain (Pl's 16 and 17), which was removed from the skull only a few hours after death. The membranes were in a high state of congestion, and a little of the surface of the left hemisphere had been disorganized by disease, otherwise the brain was in good condition. It weighed exactly 10 ounces. The brain of the Orang in its general contour resembled that of man more than those of either of the Chimpanzees which I examined. In these the brain was more elongated. The general character of the folds and fissures in the brain of the Orang, Chimpanzee, and man are the same, there are certain minor differences, however, in their disposition in all three. The fissure of Silvius in the Orang runs up and down the posterior branch pursuing only a slightly backward direction, the anterior branch is small. The fissure of Rolando, or central fissure, quite apparent, is, however, situated slightly more forward in the Orang than in man. It differentiates the frontal from the parietal lobe. The parieto-occipital fissure is well marked, bordered externally

by the first occipital fold it descends internally on the mesial side of the hemisphere, separating the parietal from the occipital lobes. In the Orang, the parieto-occipital fissure does not reach the calcarine, being separated from it by the "deuxieme plis de passage interne" of Gratiolet, or "untere innere Scheitelbogen-Windung" of Bischoff. I have noticed this separation as an anomaly more than once in man.

According to Bischoff, this disposition obtains in the Gorilla, and seems to be usual also in the Chimpanzee. In the female Chimpanzee, however, on the left side I found the parieto-occipital fissure passing into the calcarine, as in man. The frontal lobe is easily distinguished from the parietal by the fissure of Rolando, and from the temporal by the fissure of Sylvius. In the Orang it is higher, wider, and more arched than in the Chimpanzee. The anterior central convolution in front of the central fissure runs into the post-central convolution above and below, as in man. It is difficult, however, to identify the three frontal convolutions seen in man and the Chimpanzee, the frontal lobe of the Orang dividing rather into two convolutions, the middle one being badly defined. This is due somewhat to the length of the pre-central fissure, which is as long as the fissure of Rolando, extending farther upward than in man. There was nothing particularly noticeable about the base of the frontal lobe; on the mesial surface it ran into the parietal. The part above the callosomarginal fissure in the Orang is not as distinctly divided into convolutions as in man, though these are not constantly present even in all human brains. The parietal lobe is separated from the frontal by the central fissure, from the occipital and temporal incompletely, by the parieto-occipital and Sylvian fissures. The posterior-central convolution is well defined. The parietal fissure in the Orang is more striking than that of man, resembling the Gorilla's; it is twice as long as the corresponding fissure in the Chimpanzee, extending from the transverse occipital fissure, as is sometimes the case in man, almost into the fissure of Rolando. It is unbridged and without a break, and divides the parietal lobe completely into upper and lower parietal lobules. The upper parietal lobule is bounded externally by the parietal fissure; posteriorly it is separated from the occipital lobe, internally by the parieto-occipital fissure; externally it is continuous with the occipital lobe, as the first occipital gyrus, anteriorly it is sepa-

rated from the posterior central convolution more completely than in man, by a fissure which runs parallel with the central fissure. There is in the Orang, also, a fissure running parallel with the parietal, which subdivides the upper parietal lobule into inner and outer portions. The precuneus, or the space on the mesial side of the parietal lobe between the parieto-occipital fissures and the ascending branches of the calloso-marginal, is well defined. The lower parietal lobule in the Orang divides naturally into the supra-marginal and angular gyri. The supra-marginal fold curves around the upper end of the posterior branch of the fissure of Sylvius and runs into the superior temporal gyrus. The angular gyrus, which is very evident, arches around the first temporal fissure, and becoming continuous with the second occipital fold, passes then into the upper temporal gyrus. The occipital lobe, separated from the parietal, internally, by the parieto-occipital fissure, is continuous with upper parietal lobule through the first occipital gyrus, and by the second occipital gyrus with the angular. There are no sharp lines of demarkation between the occipital and temporal lobes. In the occipital lobe of my Orang the transverse occipital fissure was present, and received the parietal fissure. The calcarine fissure was well marked, but was separated in the Orang from the parieto-occipital fissure by the "deuxieme plis de passage interne" of Gratiolet, the "untere innere Scheitelbogen-Windung" of Bischoff. The cuneus of the Orang is therefore somewhat different from that of man. In man I have seen these two fissures separated as an anomaly. The calcarine passed into the hippocampal fissure, so that in the Orang, as in monkeys generally, the gyrus fornicatus was separated from the hippocampal gyrus, whereas in man these convolutions are continuous. This disposition has been noticed in the Hylobates, in Ateles, and in one Chimpanzee, where the calcarine did not reach the hippocampal. The first occipital gyrus is very well developed, and, as the late Professor Gratiolet observed, is one of the most striking convolutions in the brain of the Orang. It rises so to the surface that the internal perpendicular fissure or external part of the parieto-occipital fissure is almost entirely bridged over, the operculum so characteristic of the monkey almost disappearing. It is continuous with the upper parietal lobule arching around the parieto-occipital fissure. This convolution comes to the surface in the

Hylobates and Ateles almost to the same extent as in the Orang, but it is more developed in the latter than in the Chimpanzee. It is called also the "premier plis de passage externe," by Gratiolet, the "obere innere Scheitelbogen-Windung," by Bischoff, the "first annectant gyrus," by Huxley, and "first bridging convolution," by Turner. The second occipital convolution connects the occipital lobe with the angular gyrus. In my Orang it was partly concealed by the first occipital. It was not as superficial as in man. The third occipital gyrus is continuous with that part of the temporal lobe below the first temporal fissure. I noticed, also, in my Orang the "quatrieme plis de passage" of Gratiolet. On the mesial side of the occipital lobe in my Orang, was well seen the "deuxieme plis de passage interne" of Gratiolet, the "untere innere Scheitelbogen-Windung" of Bischoff, which separates the calcarine from the parieto-occipital fissure; and in both the Orang and Chimpanzee, more especially on the left side, I had no difficulty in recognizing the "premier plis de passage interne" of Gratiolet, its convexity turning inwards, while that of the first occipital gyrus, or the "premier plis de passage externe," turns outward. These two convolutions, the first occipital gyrus and the "premier plis de passage interne," in my Orang were continuous. They are regarded as one by Bischoff, forming his "obere innere Scheitelbogen-Windung," but as two by Gratiolet, constituting his "premier plis de passage externe et interne."

The temporal lobe in the Orang is much less convoluted than in man, or even in the Chimpanzee. The first temporal fissure and first temporal convolution are well marked, but the second and third are badly defined. The fusiform and lingual lobes are separated by the inferior occipito-temporal fissures, the collateral fissures of Huxley. The island of Reil was perfectly covered in both the Chimpanzee and the Orang by the operculum, but was not convoluted in my Orang. The surface in places was slightly roughened. I noticed, however, three or four convolutions in the Chimpanzee. On making a section of the left hemisphere of the Orang I noticed that the corpus callosum was relatively smaller than in man, but that the ventricle exhibited an anterior, middle and posterior cornu, the corpus striatum, tænia semicircularis, thalamus opticus and fornix were well developed, the hippocampus major with corpus fimbriatum were perfectly evident, and the hippocampus minor larger relatively than in man. I did

not see a trace of the emmenentia collateralis; this is often, however, absent in man.

The cerebellum in my Orang was relatively larger than that of man, but smaller than that of either the Chimpanzees I have dissected, and was just covered and no more by the posterior lobes of the cerebrum. This relation is still retained in my Orang, though the brain has been lying in alcohol for three months since it was taken out of the chloride of zinc in which it was placed until the pia mater could be removed. During this period it has been subject to the conditions, such as the want of the support of the membranes, the effect of pressure, etc., urged by Gratiolet, Huxley, Rolleston, Marshall, etc., as sufficient to explain why after death the cerebellum was uncovered by the cerebrum in the Orang and Chimpanzee, as held by Owen, Schroeder van der Kolk and Vrolik, and Bischoff. Every anatomist knows that the brain after removal from the skull, especially without the membrane, if left to itself, very soon loses its shape. It is absolutely necessary therefore to examine the brain in situ, and after removal from skull to place it in some hardening fluid in which it will float. Even with these precautions, through the change of the surroundings, shrinkage, etc., the brain is always somewhat altered. It happens, however, that I have had lying in alcohol for some years a number of human and monkey brains. Among the latter, examples of the genera *Cebus*, *Ateles*, *Macacus*, *Cynocephalus*, *Cercopithecus*, etc., taken out of the skull sufficiently carefully, but preserved in the rudest manner without any regard to the above precautions. Now, while all of these brains have somewhat lost their natural contour, they are not so changed that in a single one, human or monkey, do I find the cerebellum uncovered by the cerebrum, and in every instance the posterior lobes overlap the cerebellum to a greater extent than I find is the case in my Orang. If the cerebrum and cerebellum in the Orang and Chimpanzee invariably bear the same proportion to each other as they do in man and the monkeys, why should not the brain of an Orang or Chimpanzee, after lying in alcohol for some years, exhibit the cerebellum covered by the cerebrum as in them? Why should it be necessary to replace the brain of the Chimpanzee or the Orang in the skull, to make plaster casts, etc., if there is no difference between their brains and those of man and the

monkeys, for there is no necessity of having recourse to such measures to prove that the cerebellum is covered in the latter?

In the account I gave of the female Chimpanzee,[1] I stated that I found the cerebellum uncovered. I had the opportunity a short time since, of verifying that statement in the male, noticing in situ that the cerebellum was uncovered by the posterior lobes. This was found to be the case by Mr. Arthur Browne, the Superintendent of the Phila. Zool. Garden, in a third Chimpanzee which died there. With all deference to Prof. Marshall's[2] photograph of a plaster cast of the brain of a Chimpanzee, and however it may truthfully represent the relations of the cerebellum in his specimen, I must say that it would be simply monstrous if accepted as an illustration of either of mine, and with profound respect for Prof. Huxley's[3] opinion regarding the interior of the skull being a guide for the determination of the proportion between posterior lobe and cerebellum, I find it anything but a safe one as regards the anthropoid apes. For the space between posterior lobes of brain and dura mater and bone, both posteriorly and laterally, I find very variable in situ, due to the state of the blood vessels and amount of fluid in arachnoid and subarachnoid cavities. In speaking of the Gorilla, Prof. Bischoff[4] observes, p. 100, "Das es bei ersterem am wenigsten von oben Hinterlappen der grossen Hemisphäre bedeckt wird und bei der Betrachtung des Schädel gewiss von oben mit seinem hinterem Rande sichtbar wird." And in reference to the Chimpanzee,[5] p. 95, "Die Hinterhauptslappen des grossen Gehirns bei diesem Affen wie bei dem Menschen das kleine Gehirn überzogen und von oben fast ganz bedecken." And Vrolik[6] states, p. 7, of the Orang: "Ce lobe postérieur ne se prolonge pas autant que chéz l'homme; il ne recourve pas si bien le cervelet du moins il ne cache pas complétement surtout vers les cotés." The fact of the cerebellum being covered by the posterior lobes in my Orang and that figured by Gratiolet, and but slightly uncovered in that of Vrolik's, is no more strange than that Bischoff[7] should find it covered in one Hylobates, and Prof. Huxley[8] having stated it to be uncovered in another.

I did not observe anything particularly noticeable about the

[1] Proceed. of Acad., 1879.
[2] Natural History Review, 1861.
[3] Man's place in Nature, p. 97.
[4] Das Gehirn des Gorillas, 1877.
[5] Gehirn des Chimpanzee, 1871.
[6] Amsterdam Verslagen, Deel 13, 1862.
[7] Beitrage zur Hylobates, 1870.
[8] Vertebrate Anatomy, p. 411.

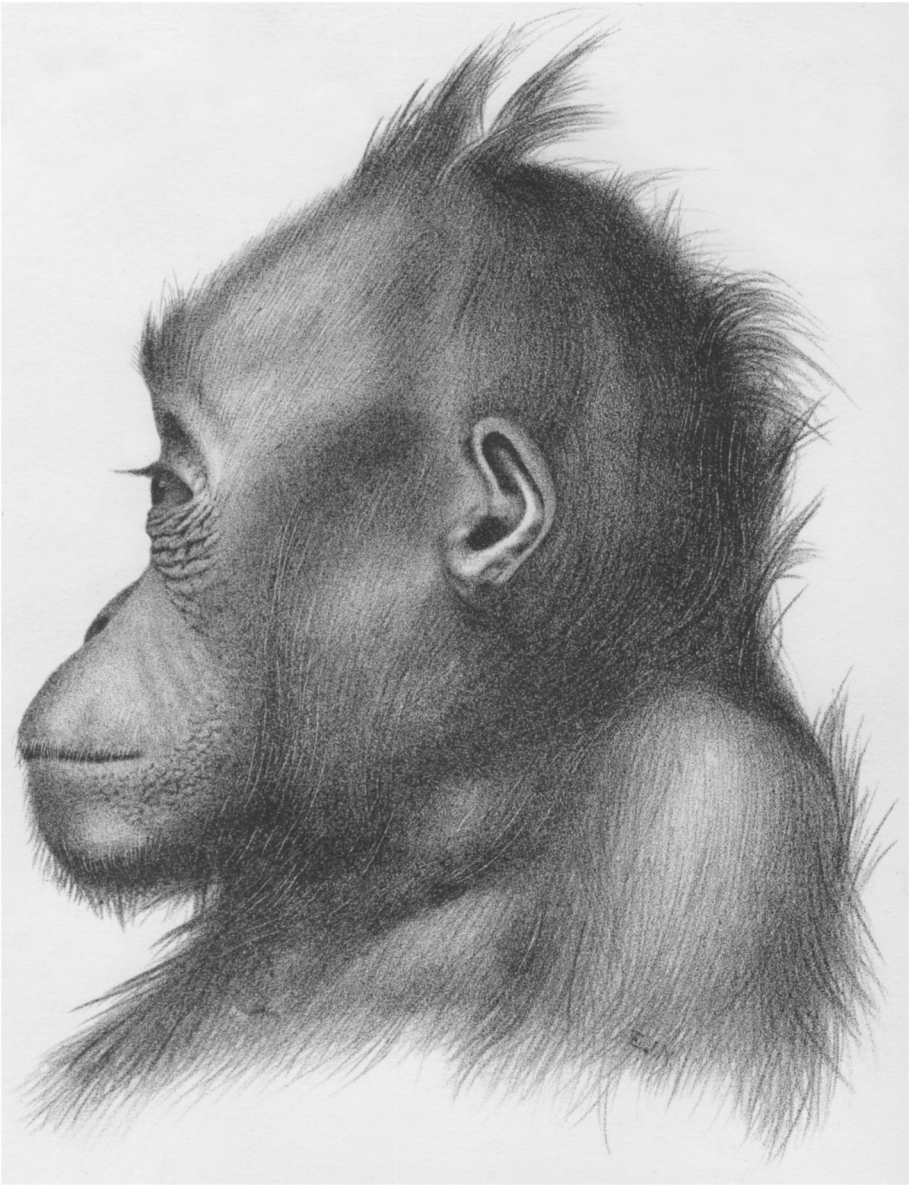
pons or medulla, except that in the latter the olivary bodies are not as distinct as in man. As regards the peripheral nervous system it was essentially the same as the human. As the brain of the Orang which I have just endeavored to describe is the property of the Academy, the animal having been bought and presented by Mr. Wm. S. Vaux, and as it was desirable to preserve it in its present condition, I could not make use of it to examine the structure minutely. I would refer those interested in the histology of the anthropoid brain, to Dr. Spitzka's paper.[1]

What can be inferred from the general organization of the Orang as to its relation to the other primates? The Orang like man has twelve ribs, whereas the Gorilla and Chimpanzee have thirteen; on the other hand the carpal and tarsal bones are nine in number in the Orang, while the Chimpanzee and Gorilla agree with man in having eight. The upper extremity of the Orang resembles that of the Gorilla in the absence of the flexor longus pollicis. The Chimpanzee and man are alike in this respect, at least the slip from the flexor longus digitorum in the former is functionally a flexor longus. In the absence of a flexor longus hallucis, and in the presence of an opponens hallucis, the Orang differs from man, the anthropoids and all the monkeys. The great blood-vessels arise from the arch of aorta in the Gorilla and man in the same way; the same disposition is usually seen in the Chimpanzee, rarely in the Orang. The lungs in the Orang are not divided into lobes as in the Gorilla, Chimpanzee and man. The stomach in the Gorilla and Chimpanzee is human in its form; in the Orang, however, it is quite different. The peritoneum in the Gorilla, Chimpanzee and Orang is like that of man; in the lower monkeys it is different. The brain of the Orang in its globular form, in the cerebellum being usually covered by the cerebrum, and in the development of the first occipital gyrus, resembles man more than that of the Gorilla and Chimpanzee. On the other hand, the frontal and temporal lobes in the Orang are not as much convoluted as in the Chimpanzee, and still less than in man, and the island of Reil is not convoluted at all, at least in my Orang.

It will be seen from the above illustrations, of which many others might be given, that the Gorilla and man, in some respects, agree with and differ from the Chimpanzee and Orang; while

[1] Op. cit.

from other points of view the Orang approaches man more closely than either the Gorilla or Chimpanzee, and that as regards certain muscles, man and the lower monkeys agree in having them, while they are absent in the anthropoids. From these facts we may reasonably infer that the ancestral form of man was intermediate in character as compared with the living anthropoids or lower monkeys, agreeing with them in some respects, and differing from them in others. The Orang is closely allied to the Gibbons, the Chimpanzee to the Macacques, and the gap between these and the *Semnopithecus* is bridged over by the *Mesopithecus* of Gaudry. Until, however, the paleontologist will have procured more material like that from Pikermi, and interpreted it as ably, it will seem to me premature to offer any detailed genealogical tree of the Primates.



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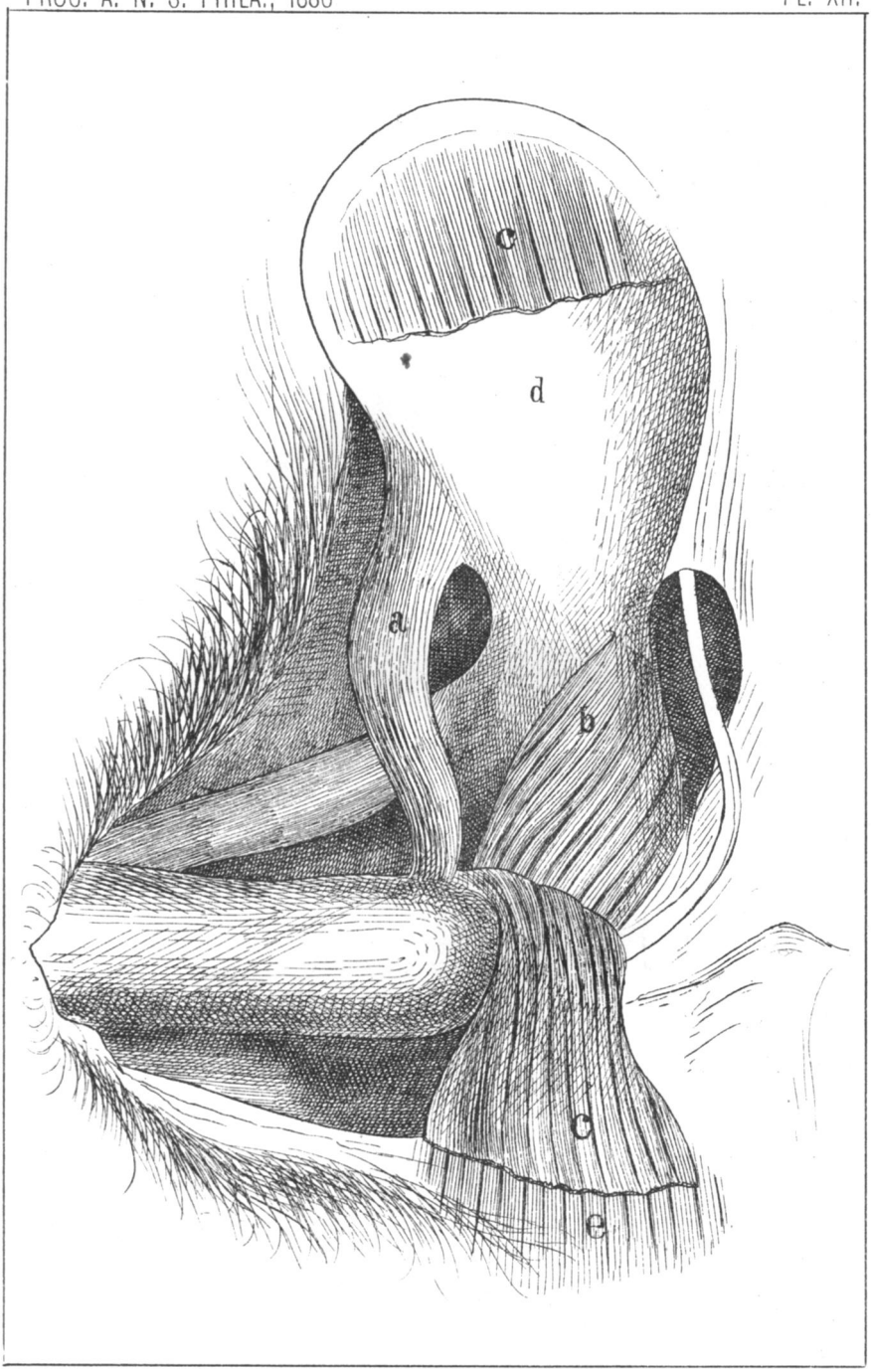
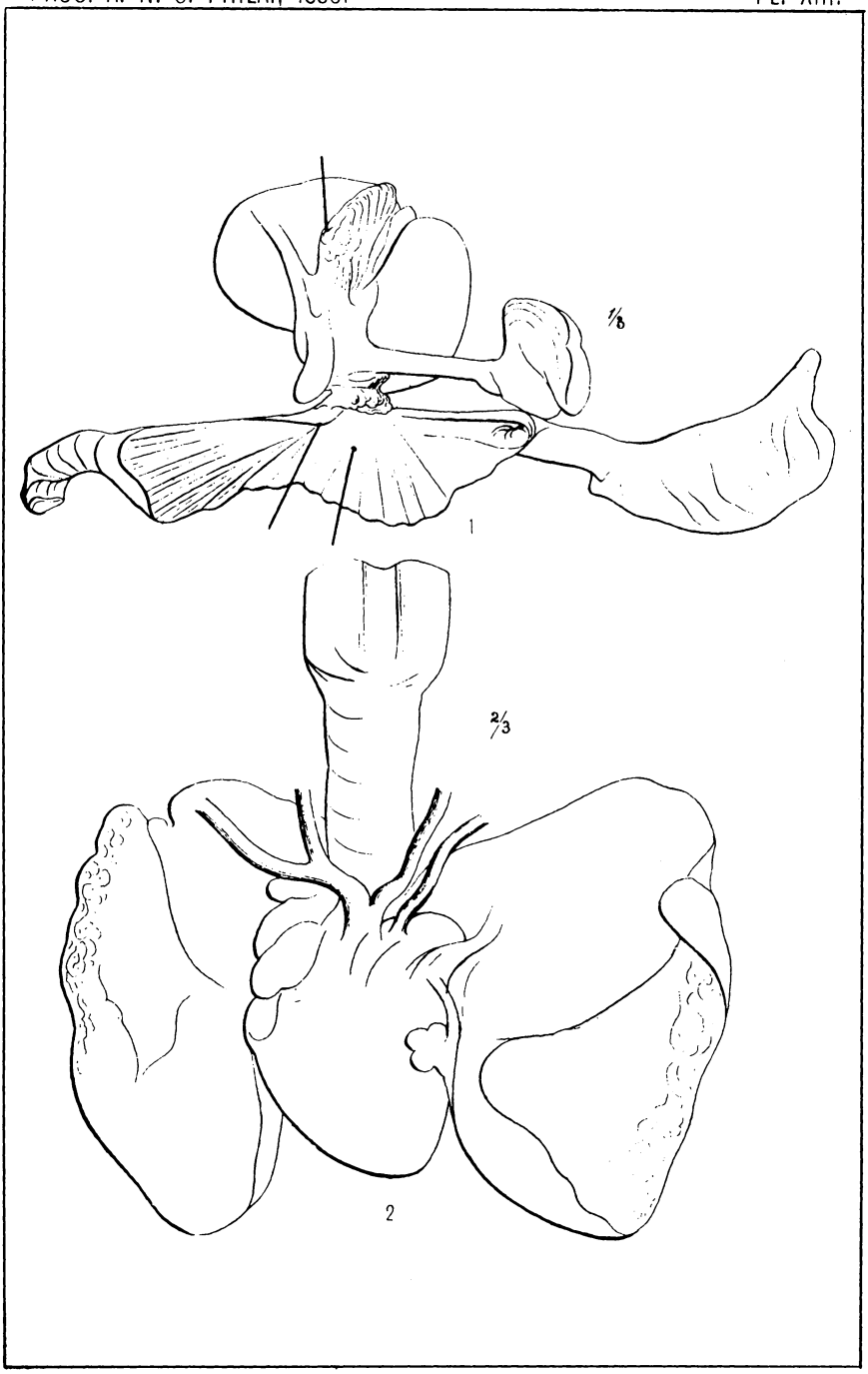


CHAPMAN, ANATOMY OF ORANG OUTANG.



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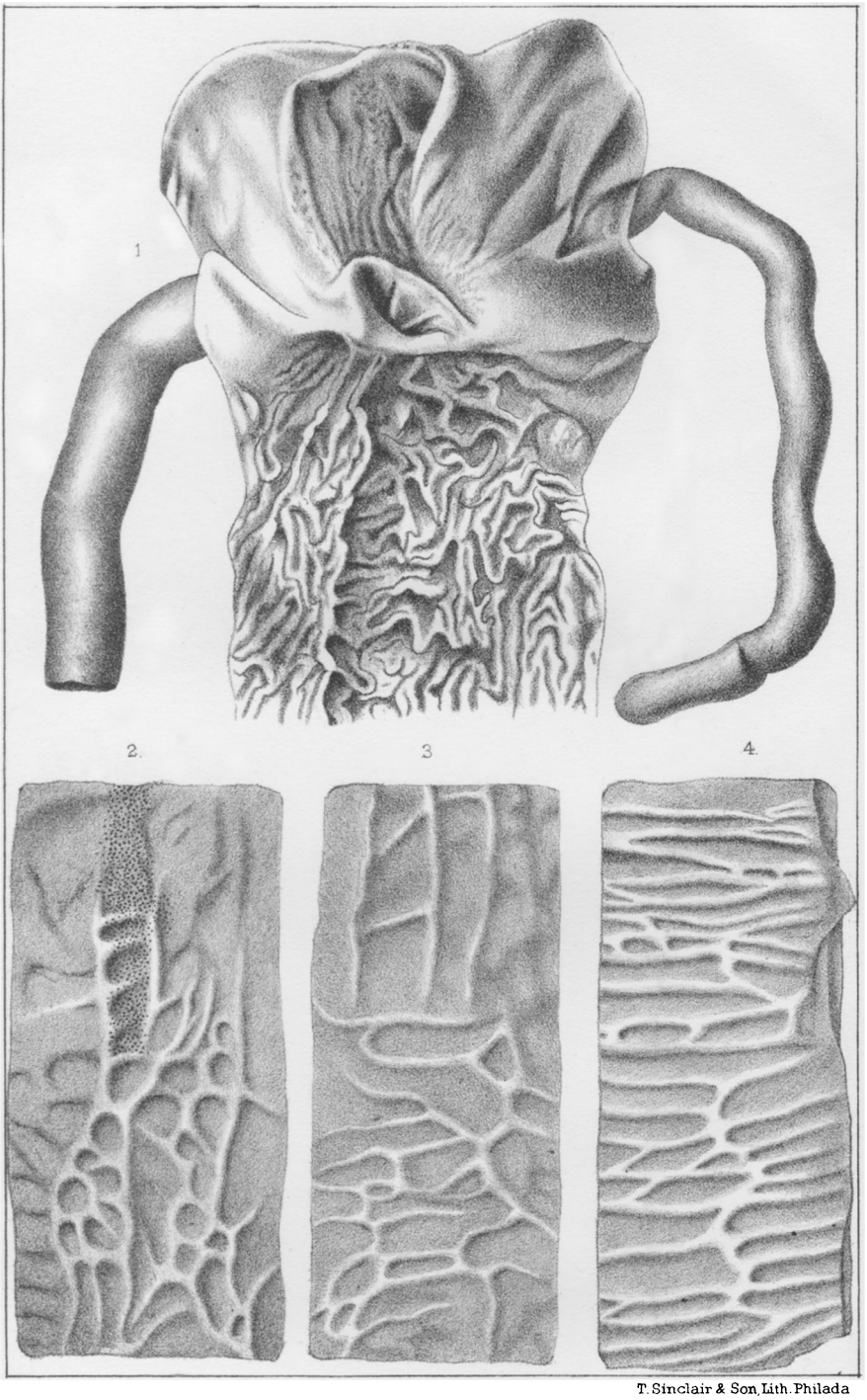
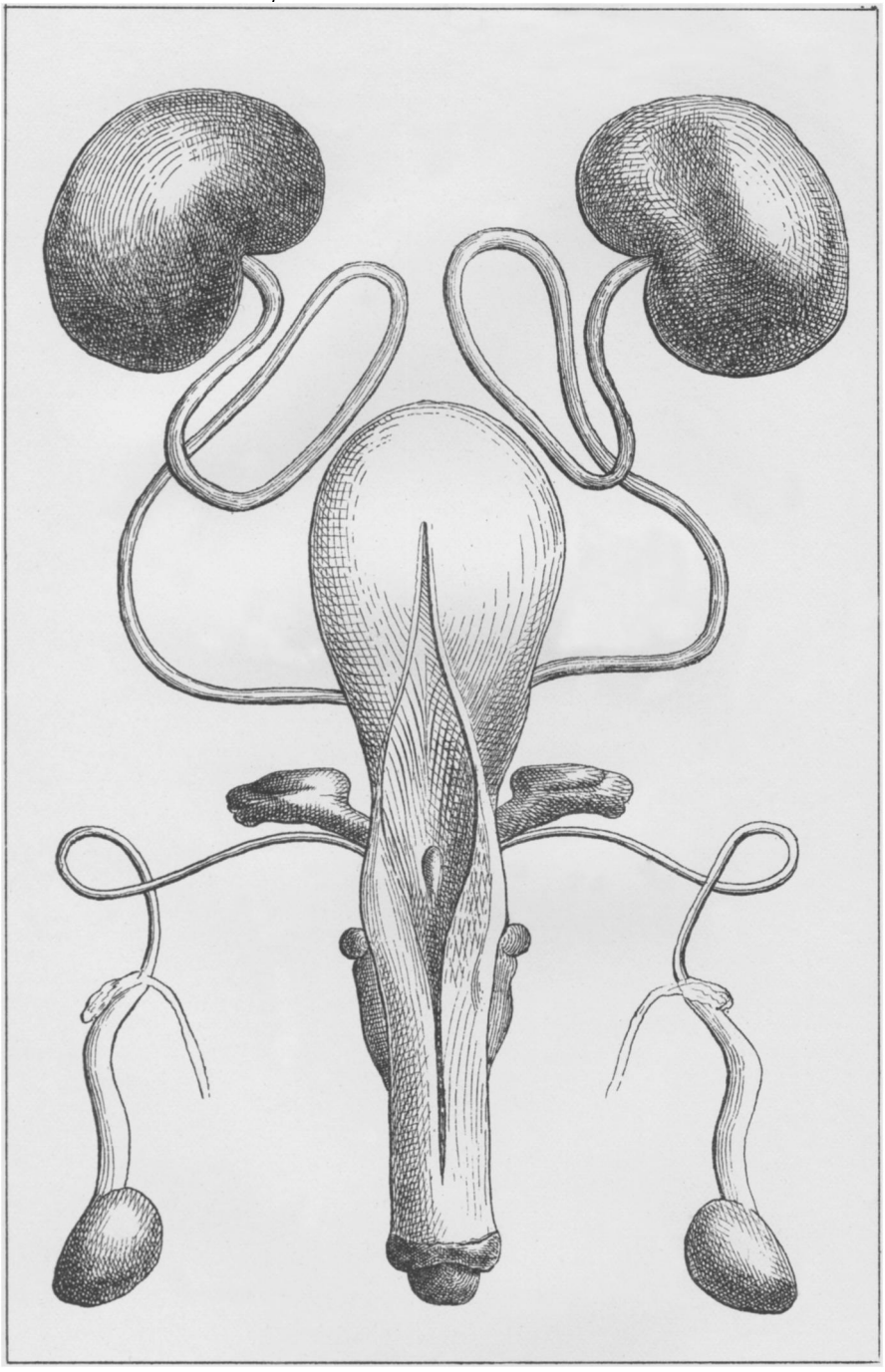


T. Sinclair & Son, Lith. Philada

Chapman, Anatomy of Ourang Otang.



CHAPMAN, ANATOMY OF ORANG OUTANG.

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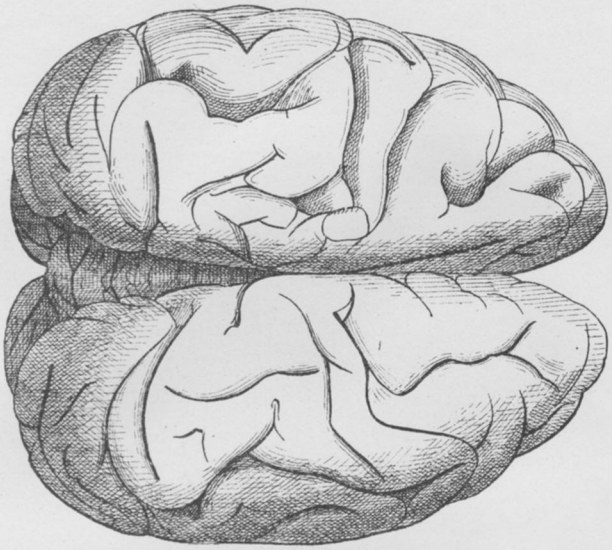

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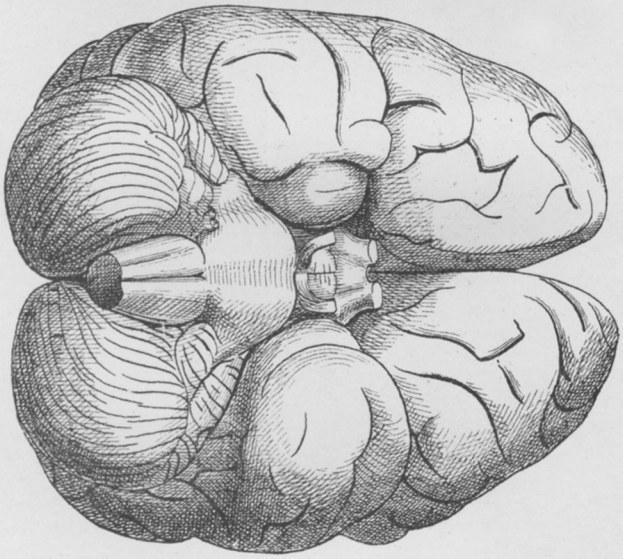

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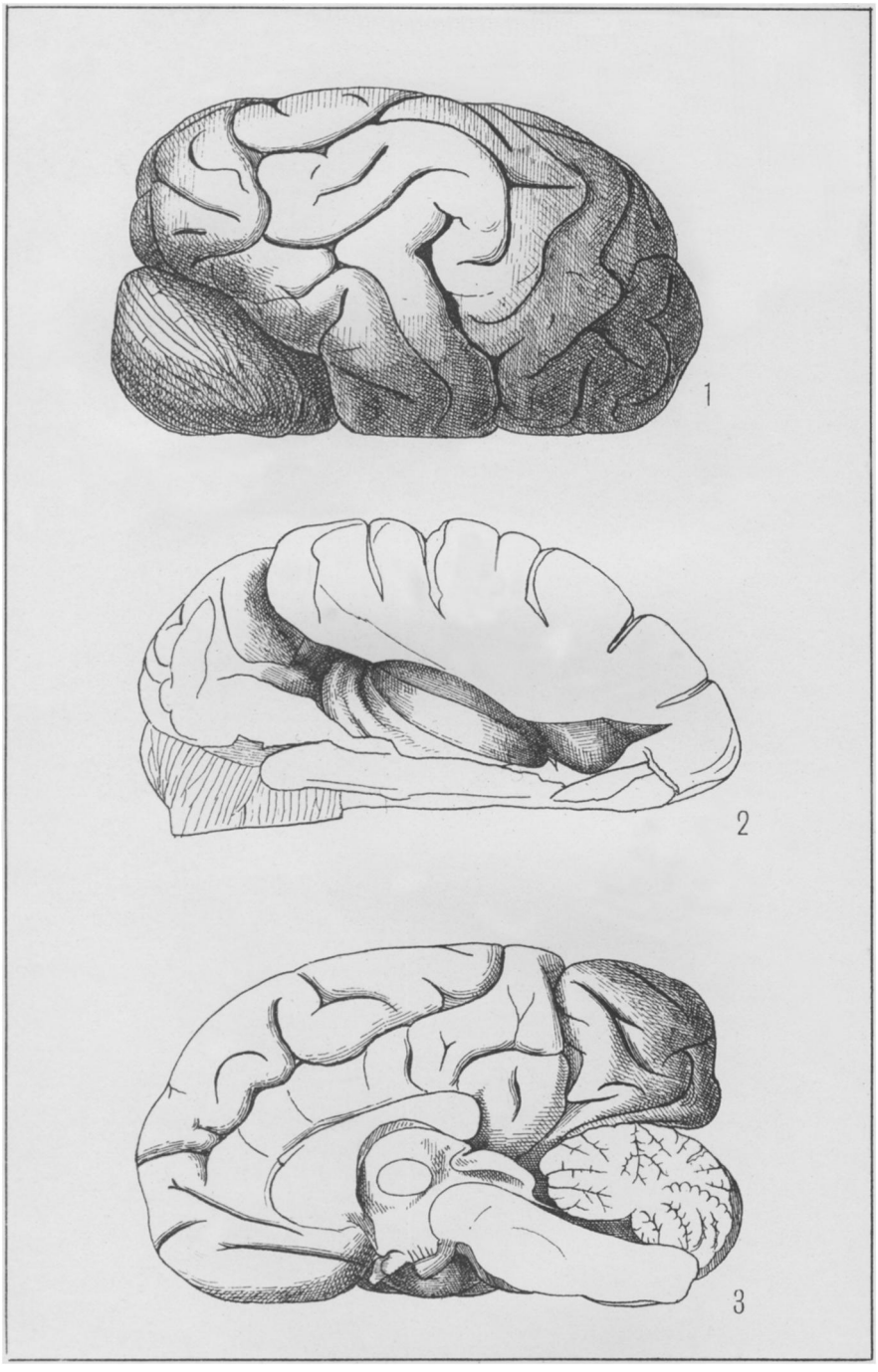

CHAPMAN, ANATOMY OF ORANG OUTANG.